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REPORT I

THE SHARK BAY FISHERY ON SNAPPER *CHRYSOPHRYS UNICOLOR*

(Quoy and Gaimard)

By
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Published by the Director of Fisheries, Perth, under the authority of the Hon. Ross Hutchinson, M.L.A., Minister for Fisheries

By Authority: ALEX. B. DAVIES, Government Printer

1961

45324/3/61—250

Fisheries Department, Western Australia

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I - INTRODUCTION

As regards both catch and value, the Shark Bay snapper fishery is the second most important scale fishery in Western Australia. Until 1959, the fishing was done solely by means of hand-lines operated from boats drifting over the snapper patches. In 1959 traps were first used with great success and in 1960 this method of fishing was again the principal technique.

Prior to the 1960 season there were several suggestions that the use of traps would have a deleterious effect on the fishery. On October 19, 1959, the Western Australian League of the Professional Fishermen's Association wrote to the Fisheries Department requesting that "this method (trapping) of taking fish in the Shark Bay area be totally banned inside Dirk Hartog Island from Steep Point to Cape Inscription, and during the snapper schooling season in outside waters from May 15 to August 31, both dates inclusive." It was, therefore, decided to investigate the effect of snapper-traps during the 1960 season, using the research vessel "Lancelin" to facilitate the study.

At the close of the 1960 season, the majority of the snapper fishermen were interviewed to obtain statistical data for comparison in future years. A detailed study of the 1960 season was also undertaken because press reports had indicated that the season was one of the worst on record.

The results of the various lines of investigation are set out below together with a discussion and recommendations.

II - DESCRIPTION OF THE FISHERY

(a) Areas of operation

The fishery extends from South Passage at the southern extremity of Dirk Hartog Island to Koks Island lying north of Bernier Island (Fig. 1). Snapper are caught to the west of Bernier, Dorre and Dirk Hartog Islands, but the two principal areas are in the vicinity of Koks Island and Cape Inscription. In addition, a small quantity of fish is caught in the vicinity of Cape Cuvier. What is known as the Shark Bay snapper fishery does not therefore exist within the Bay itself, but to the west and north of the islands bounding it.

The block system used by the Fisheries Department for the recording of fishermen's catches divides the coastal waters into

areas measuring one degree of latitude by one degree of longitude. Unfortunately, longitude 113°E divides the Cape Inscription area into blocks 54 and 55 and fishermen cross back and forth operating to the west and to the east of the line at random. It is therefore impossible for a fisherman to specify the weight of snapper actually caught in each block. As a result, it has been found necessary to combine blocks 54 and 55 and refer to them as the Cape Inscription area. In addition, a few fishermen have registered block 58 as the fishing area but when questioned have shown that they were not operating so far west. The figures for block 58 have, therefore, been grouped with block 57 and called the Koks Island area.

Snapper exist in large quantities within Shark Bay proper, but the poundage taken by professional fishermen is small compared with the State's total (10% in 1959) and, in addition, the fishermen working there reside at either Shark Bay or Carnarvon. Block 55 covers a large portion of the Bay but the majority of the snapper taken from this area are caught during the season at Cape Inscription (84% in 1959).

Although the area over which snapper may be caught is large, the specific patches are small and it is possible for a fisherman to catch snapper in quantity on a particular patch while another fisherman close by catches very little. As a result, the efficiency of a fisherman largely depends upon his ability to locate the various patches within the fishing area.

(b) Operators

The majority of the vessels operating during the snapper season are freezer boats from Fremantle and during the 1960 season they numbered 19. Two ice-boats, two freezer-boats and eight catcher-boats operated from Geraldton.

(c) Period of Operation

In late May or early June snapper school in the various areas described above. The ovaries are in ripening condition and the fish evidently schooling preparatory to spawning. It is this stock on which the fishery operates. The boats move into the area during the first weeks of June and, depending upon the success of the season, remain there until late August. This fishery, operating on schooling fish, is distinct from the small fishery within the Bay which continues during the whole of the year on virtually resident stocks.

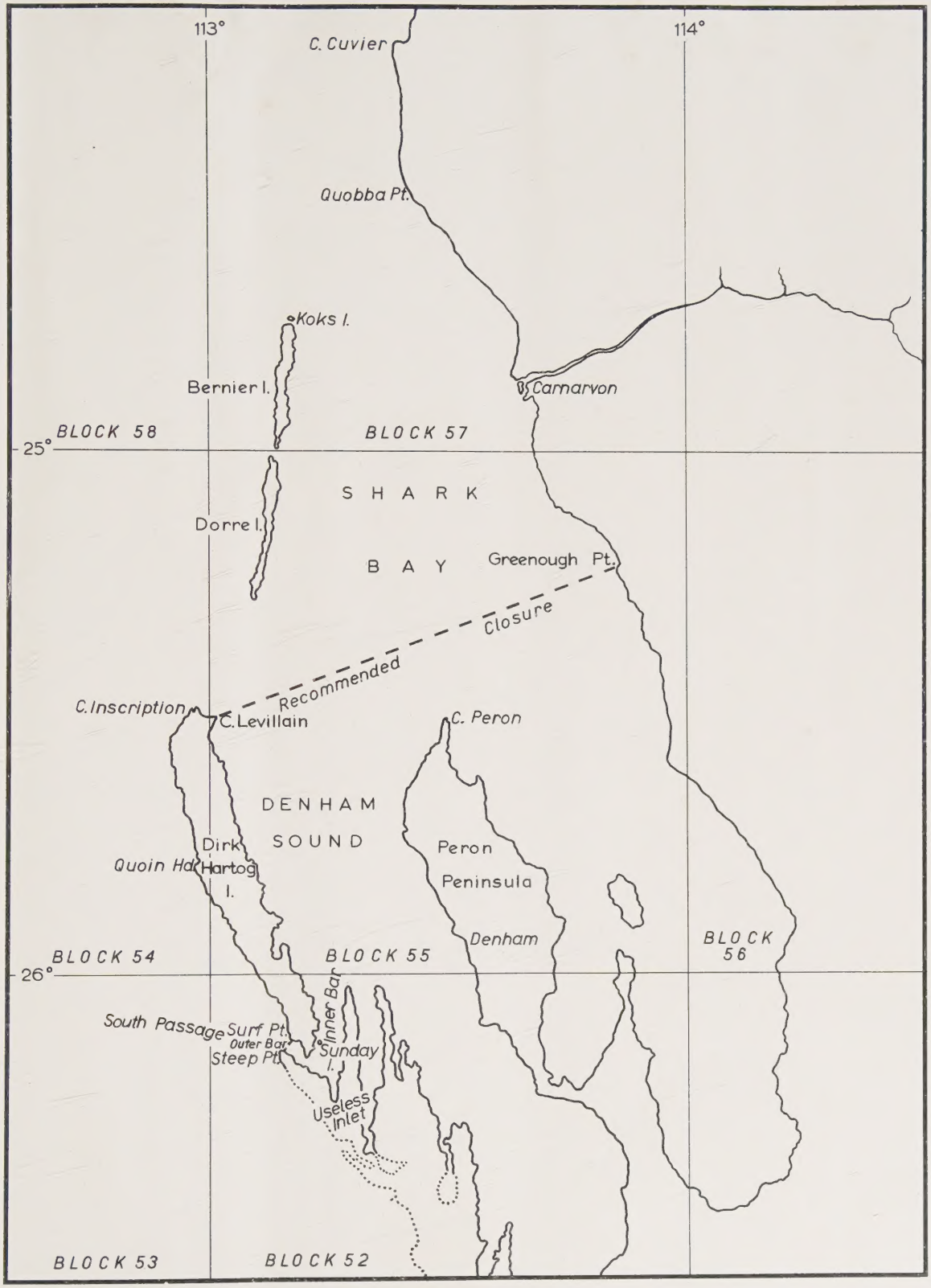

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FIG. 1 MAP OF SHARK BAY

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(d) Fishing Methods

(i) Prior to 1959. - Hand-lining was the sole method in use prior to 1959. A line of vessels drifted over a series of patches on a given ground and snapper were caught as each patch was located. As each vessel drifted away from the ground it moved to the top of the line and recommenced fishing. In this way each vessel had the opportunity of fishing all patches. However, by reason of the fact that each vessel drifted off the patches in turn, there were considerable periods during the day when a particular vessel was not fishing. The estimated effective fishing time was about four hours a day.

(ii) 1959 and 1960. - The snapper-trap came into prominence in 1959 and was again used in 1960. The trap is circular in shape and measures about 4 feet in diameter and 20 inches in height (Fig. 2). The frame is of mild steel and this is covered by wire netting or loose link mesh netting. Although this was the principal method in use, fishermen also used hand-lines while waiting to pull their traps. However, this was very much secondary to the main task of trap fishing. It is virtually impossible for a fisherman to fish solely by hand-line where traps are being operated because of the difficulty of drifting between boats and buoys. A major difference between the hand-lining method used prior to 1959 and trapping is that a fisherman is able to drop his traps and thus fish a precise position. He may then fish that area for as long as he wishes. It follows, then, that the fisherman with the greatest knowledge of the snapper patches is the most efficient. When hand-lining was the only method in use, each fisherman had a reasonable chance of drifting over the best patches whether the exact locality was known or not. A further difference is that traps effectively fish for a full eight hours a day.

The storage capacity of each boat controls the length of time it remains on the snapper grounds. When a full load of fish is obtained, the boat returns to either Fremantle or Geraldton to off-load its catch. During the season a vessel may make four trips although the average for 1960 was two to three.

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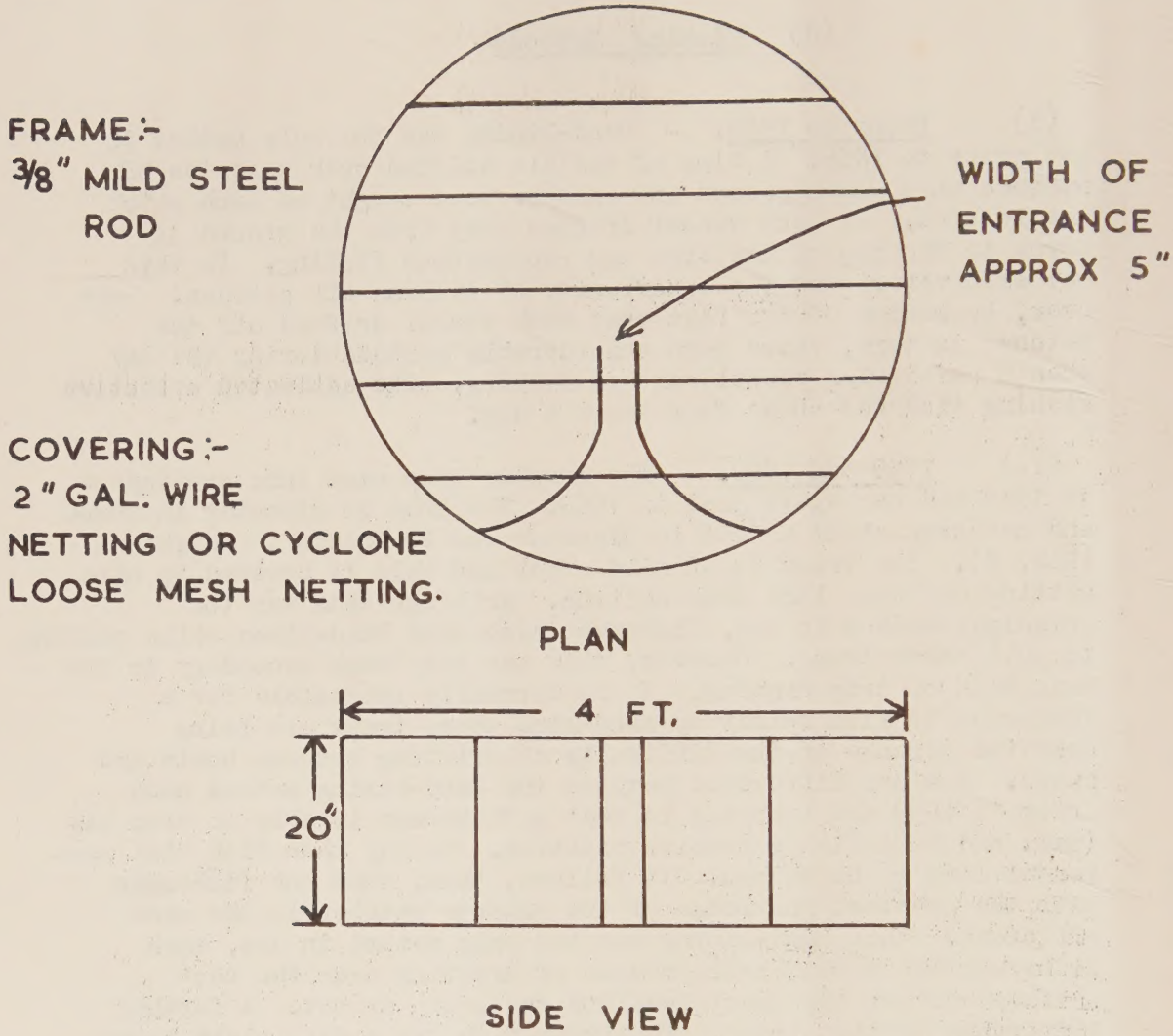

Fig. 2. Plan and side view of snapper trap used in Western Australia. (after "Fisheries Newsletter")

III - ANNUAL PRODUCTION

The snapper season production figures for the years 1952 to 1960 inclusive are set out in Table 1, and the increase in production during 1959 and 1960 is most marked.

Table 1.

Shark Bay Snapper Season Production Figures, June, July and August.

YEAR	Block 52	Blocks 54 and 55	Blocks 57 and 58	Total	Percentage of State's Annual Snapper Production
	lb.	lb.	lb.	lb.	
1952	148,853	231,826	22,089	402,768	40
1953	32,253	471,039	171,313	674,605	57
1954	73,858	460,340	259,042	793,240	61
1955	48,163	574,040	432,666	1,054,869	76
1956	28,656	673,799	329,767	1,032,222	73
1957	33,269	397,995	76,973	508,237	60
1958	15,873	376,206	227,853	619,932	67
1959	50,703	932,483	681,131	1,664,317	81
1960	54,291	184,123	1,229,861	1,468,275	Not Available

In 1959, the total number of vessels working during the snapper season was 35, but this figure included many small catcher-boats which did not contribute a great poundage to the overall production. In fact there were 17 freezer-boats on the grounds and they caught 81% of the total catch. It is unwise, therefore, to attempt an analysis of the catch figures of previous years to determine the catch-per-boat or catch-per-man. The resultant figures would be unreal. As mentioned above, it is the freezer-boats which constitute the fishing pressure, and it is their catch-per-unit-effort data which are important. The catch per boat for these vessels in 1959 was 79,658 lb. of snapper (round weight).

In 1960 there were 31 boats operating during the snapper season, although 84% of the catch was caught by 21 freezer-boats. The catch per freezer-boat was 58,933 lb.

IV - 1960 SEASON

(a) Duration of Season

It is difficult to obtain accurate data on the movement of vessels. However, on a number of occasions it was possible to examine

a ship's log and thus obtain very valuable information with regard to fishing dates and the number of fish caught on each day. From such information it may be definitely stated that at least one vessel was on the fishing grounds on June 1 and by the end of the first week of June there were three others. By mid-June most of the boats were on the grounds.

By the end of July all the boats had vacated the Cape Inscription area, although five still remained at Koks Island. These vessels fished during August and then returned to port.

(b) Catch per day

There were 21 freezer-boats fishing for snapper during the season, and they caught 84% of the total catch. These boats, therefore, constituted the most important section of the snapper fleet. Accurate information on actual fishing time was obtained from ten of these vessels, and it is reasonable to assume that this information is representative of the fleet. The catch-per-day data is set out in Table 2 and it is clear that the vessels on the fishing grounds during the first two weeks of June obtained some excellent catches.

Table 2

Catch-per-day Data for Cape Inscription and Koks Island Areas.

1960 Month	Cape Inscription area		Koks Island area	
	Catch per day per boat	No. of vessels concerned	Catch per day per boat	No. of vessels concerned
	lb.		lb.	
June 1-15	5,200	1	3,000	3
June 16-30	1,300	1	2,100	6
July	1,300	1	1,800	9
August	-	-	892	5

The catch-per-day data agree with the general comments of the fishermen, viz., that those fishermen who were on either of the two major grounds early in the season obtained good catches but that later the fishing in the Cape Inscription area was very poor. In fact, of the 19 Fremantle vessels, 17 caught the major portion of their catch in the Koks Island area, including the western side of Bernier Island.

Snapper trap used in Western Australia

L.F.B. "Lady of Fatima" hauling Snapper trap
at Shark Bay

(photos courtesy "W.A. Newspapers")

(c) Length Frequencies

To allow a comparison to be made between the lengths of snapper caught by hand lines and by traps, the research vessel "Lancelin" used both methods simultaneously. In addition, towards the end of July some of the fishing boats combined trap- and line-fishing and the opportunity was taken to obtain further measurements of snapper caught by both methods. The results obtained from r.v. "Lancelin" and two commercial vessels has been compounded and set out in Table 3. As the means of the two samples (27.3 and 26.5 in.) differ significantly at the 95% level, it seems as though there may be a size selectivity by the trapping method compared with hand-lining. The table also shows that all the snapper taken were well above the minimum legal length of 11 inches. Throughout the course of the investigations many hundreds of snapper caught by the fishermen were inspected, but no undersize fish was found.

Table 3

Length-frequencies of Snapper Sample Caught by Trap and Line at Koks Island area, 25.6.60 to 21.8.60.

Total Length	Frequency	
	Trapped Fish	Line-caught fish
in.		
15	2	3
16	4	6
17	3	-
18	2	5
19	2	1
20	-	1
21	3	-
22	3	14
23	11	12
24	15	22
25	23	23
26	29	27
27	27	36
28	47	39
29	53	38
30	39	26
31	20	13
32	10	5
33	-	1
34	2	2
Total	295	274
Mean	27.3 in.	26.5 in.
Standard Deviation	3.3 in.	3.5 in.

Length-frequencies of fish measured at Quoin Head, Surf Point and Outer Bar are given in Tables 4 and 5.

Table 4.

Length- and Weight-Frequencies of Snapper Caught by Line at Quoin Head, 4.8.60.

Total Length	Frequency	Total Weight	Frequency
in.		lb.	
14	1	1	1
15	3	2	5
16	3	3	6
17	2	4	7
18	1	5	5
19	1	6	7
20	2	7	6
21	4		
22	8		
23	3		
24	6		
25	2		
26	1		
Total	37	Total	37
Mean	20.7 in.	Mean	4.5 lb.
Standard Deviation	3.3 in.	Standard Deviation	1.7 lb.

Table 5.

Length- and Weight-Frequencies of Snapper Caught by Line at Surf Point and Outer Bar, 4.8.1960 to 5.8.1960.

Total Length	Frequency	Total Weight	Frequency
in.		lb.	
16	1	3	1
17	-	4	1
18	-	5	11
19	-	6	11
20	3	7	5
21	5	8	11
22	9	9	1
23	10	10	2
24	6		
25	3		
26	3		
27	2		
28	1		
Total	43	Total	43
Mean	23 in.	Mean	6.5 lb.
Standard Deviation	1.8 in.	Standard Deviation	1.6 lb.

A small number of fish were caught in the vicinity of Peron Peninsular and Sunday Island, Shark Bay, and the length-frequencies are set out in Table 6, together with snapper measured during a tagging programme in Useless Inlet in July, 1954. Although it is not suggested that the measurements in Table 6 represent the majority of the snapper within Shark Bay, they do show that fish measuring less than the minimum legal length exist in these waters.

Table 6

Length Frequencies of Snapper Caught by Line at Sunday Island, Peron Peninsular and Useless Inlet, 16.8.1960 to 2.9.1960, 16.7.1954 and 22.7.1954

Total Length	Frequency
in.	
7	15
8	52
9	55
10	37
11	22
12	8
13	6
14	6
Total	201
Mean	9.4 in.
Standard Deviation	1.6 in.

(i) Weight Frequencies.

Weight-frequencies of the fish examined are given in Tables 4, 5 and 7. Also, the logs of three vessels recorded the actual number of snapper caught on each day. It was possible, therefore, to calculate the average weight of the fish caught during each trip as the total weight of the fish placed in the mainland cold storage at Fremantle or Geraldton was recorded. The average weights (in pounds round weight) for seven trips were as follows :- 8.1, 8.2, 8.5, 9.2, 9.5, 9.5, and 10.2 lb. It is interesting to note that when a fisherman refers to a small snapper he means a fish of about 2 to 3 lb. weight which measures approximately 16 inches in total length.

Table 7

Weight-Frequencies of Snapper Caught by Trap and Line at Koks Island Area, 25.6.60 to 21.8.60

Whole Weight	Frequency	
	Trapped Fish	Line-caught Fish
lb.		
1	-	4
2	7	5
3	3	4
4	4	5
5	10	15
6	12	21
7	24	21
8	27	25
9	25	29
10	19	26
11	31	15
12	16	22
13	12	6
14	4	6
15	2	-
16	2	1
17	-	1
Total	198	206
Mean	8.9 lb.	8.4 lb.
Standard Deviation	2.9 lb.	3.0 lb.

(e) Weather

Consistent winds from the south-east were experienced during June, July and August. According to the fishermen there was more inclement weather than in previous years and south-easterly winds blew for days on end. As the Turtle Bay anchorage is suitable only when the weather is from the south-west to south-south-east, it was difficult to work the Cape Inscription area. It may have been partly for this reason that there were so few boats working that ground.

V - TRAP-FISHING

There is no general agreement amongst fishermen and others with

respect to the effect of trap-fishing. The various arguments for and against the technique are listed below together with comments. Of the 19 boat skippers interviewed, 12 were in favour of the use of traps and 7 were against them.

(a) Points in favour of traps.

(i) Efficiency. - Trap-fishing, when snapper are abundant, is more efficient than line-fishing. An excellent daily catch by means of line is about 300 fish, whereas one vessel caught about 1,000 by trapping during one day early in June. Another vessel caught 700 fish in a day and catches of over 300 were common. One vessel averaged more than 300 snapper a day during her first trip and just under 300 a day during the next trip. However, as the season progressed the traps caught very much less and many fishermen were forced to use hand-lines as well as traps. By experience, the fishermen found that the traps were most efficient when fish were apparently abundant but, as the season progressed and presumably the population became less dense, line-fishing became of equal value. The number of snapper caught by one boat on July 24 and 25, 1960, was 131 by trapping and 143 by line-fishing.

Trap-fishing is also more efficient in another sense. Traps have an effective fishing time of about 8 hours a day as against lines which have about 4 hours a day only.

(ii) Accuracy of fishing position.-- This is closely linked with efficiency. A fisherman with an accurate knowledge of the local snapper patches is able to place his traps on the best fishing grounds. On the other hand, because of the relative smallness of the patches, the fisherman without accurate sightings may continually obtain poor catches. To the experienced fisherman with local knowledge this aspect is definitely a point in favour of trap-fishing.

(b) Points against the use of traps.

(i) Number of fish caught. - It has been suggested that traps are too efficient and that as a consequence the grounds will be depleted through overfishing. Without any knowledge of past or present fishing pressure, in terms of the proportion of the population caught, it is impossible to say whether the fishing mortality in 1959 and 1960 was dangerously high. As a consequence it is not possible to postulate future events.

(ii) Size of fish caught. - A report on Fisheries Department file 124/48 indicates that undersize snapper have been trapped in the vicinity of South Passage, Shark Bay. There is little doubt that traps, set on a patch inhabited by small fish, will catch small fish. However,

the problem does not arise on the recognised "seasonal" grounds as all the fish taken are well above the minimum legal size (Section IVc).

(iii) Damage to habitat. - The traps are dropped on the various patches and pulled to the surface about every 15 minutes. They often have pieces of coral attached to the wire meshes and there is no doubt that the habitat suffers some damage. However, it is impossible to gauge the extent of the damage, or its effect on the snapper population. It must be remembered that many methods of fishing alter the sea-bed in some manner.

(iv) Continued fishing by lost traps. - It is common for a trap to become snagged on the rocks and be lost to the fisherman. It is possible that these traps continue to fish with a self-baiting mechanism and hence destroy fish, although the crew of "Lancelin" found that fish was a poor bait compared with crayfish heads. However, the snapper caught during the season are those which have schooled prior to spawning; the season lasts for about three months only, and then the fish disperse. If traps are lost and continue to destroy fish, their effective fishing time on a concentrated school of fish would be until the end of the schooling season only. In addition, it may be argued that the lost traps simply add an additional predator (of which there are many) to the fish population. A further point in this connection is the length of time the lost trap remains before it either rusts and ceases to be a trap or becomes encrusted with coral. Information is not available on these aspects.

(v) Bruised Fish. - Fish caught in traps are often bruised on the nape and snout. In addition, it is common for body scales to be missing and after the fish have been frozen and thawed, these scaled areas show up as bruises. If a trapped fish is placed on ice instead of being frozen, the bruised area becomes noticeable very much more quickly and thus it is very difficult for an ice-boat to use traps. During the 1960 season, one ice-boat did use this method of fishing but the crew pulled their traps regularly every 10 to 15 minutes and hence avoided much bruising. It appears, therefore, that bruising really becomes a problem only if the traps are left in the water for long periods of time.

VI - DISCUSSION

There are two main points to be considered. Firstly, was the 1960 season a failure and, secondly, what are the possible future effects of trap-fishing?

The 1960 Shark Bay snapper season produced 1,468,275 lb. of snapper, which is the second highest catch on record. This figure is 88% of the record catch taken in 1959 and exceeds the best hand-line

catch (1955) by 39%. The 1956 production was approximately the same as 1955 but in each of the two years immediately following production decreased to about one-half of the 1955 figure (Table 1). The departmental statistics do not show a significant fall in the number of boats fishing during 1957 and 1958, and it is therefore reasonable to assume that there was a decrease in the number of fish available to the fishermen. With the knowledge that this type of fluctuation has taken place in previous years it is unreasonable to suggest that the 1960 season was a failure. It is true that the season was short and most of the boats had left the grounds by the end of July, but in that time 1.31 million pounds of snapper had been caught. This was higher than the catch at the same date in 1959 (1.26 million pounds). The season, therefore, although finishing early, and although the catch per freezer-boat was lower than in 1959, can by no means be considered a failure.

The second question to be considered is the possible future effects of trap-fishing.

Evidence on fishing mortality is not available and consequently it is impossible to postulate the effect of increased production. However, it seems incredible that the present fishing intensity would cause mortality by fishing to rise to a dangerously high level, although consideration should be given to the collection of more detailed statistical data to allow the effect of increased fishing pressure to be determined in future years.

Modern fisheries scientists are still debating whether or not a fish should be allowed to spawn before it is caught. The effect, therefore, of taking undersize fish is open to considerable doubt. The problem does not however present itself on the seasonal grounds as the fish caught by means of traps are all of large size (Table 3). In fact, in the sample taken, the average length of snapper caught by trapping was larger than those caught by line. In addition, during the course of the investigation, many hundreds of snapper were examined but not one was found to be less than the minimum legal length. On the other hand, Table 6 shows that undersize snapper do exist within Shark Bay and they may, presumably, be trapped. They may equally well be caught by hand-line. But there is another consideration with regard to the snapper within Shark Bay. Complaints have been received indicating that crayfishermen have set traps to the east of Dirk Hartog Island for the express purpose of using the snapper caught in them to bait their craypots, which are set to the west of the Island. Of necessity, the traps are left for long periods of time. This results in the death of many fish, most of which are very close to the minimum legal length. It seems that traps used in this manner could kill undersize fish and that there is a case for considering the banning of traps in this area. In addition, the Shark Bay fishermen are mainly concerned with catching whiting and it is unlikely that such a ban would impose hardship on them.

The snapper habitat is damaged by the traps and anchor chains as invariably pieces of coral are adhering to them when pulled to the surface. However, it is impossible to assess the extent of this damage or the effect on the schooling snapper. It has been suggested that, as a result of the damage, the snapper will not school on their old patches and that the fishing will deteriorate as a consequence. The extremely poor production in the Cape Inscription area during the 1960 season has been cited as an example of the result of trap-fishing. However, 0.68 million pounds of snapper were caught in the Koks Island area in 1959, mainly by traps, and in 1960 the production was almost doubled. It is difficult, therefore, to explain the various fluctuations which occur, but it is doubtful whether we have sufficient information available to postulate that the habitat damage will really cause the fish to avoid their favourite schooling patches.

The function of the Department is to manage the various fisheries to ensure a stable or expanding industry. As the efficiency of fishing methods improves, it is undoubtedly the Department's duty to consider the new techniques and their possible effect on the fishery. However, more efficient methods, with resultant increased catches, are economically of great importance to the fishermen, and the Department must be in possession of sound evidence before improved techniques are banned.

Sufficient evidence is not available to support the general banning of snapper traps as a fishing technique. However, it is recommended that the collection of statistical data relating to the snapper season be intensified. Length-frequency data, more precise catch-per-effort and area data, as well as total production, should be obtained. This information would allow periodic appraisals from a statistical viewpoint, although biological knowledge would still be lacking. To prevent the destruction of borderline snapper, i.e., fish at just about the legal minimum length, it is further recommended that the use of traps be banned to the east of Dirk Hartog Island. The boundaries suggested are the eastern shoreline of Dirk Hartog Island from Surf Point to Cape Levillain, a line from Cape Levillain to Greenough Point on the mainland, the mainland shoreline from Greenough Point to Steep Point (South Passage) and a line from Steep Point to Surf Point. The boundaries encompass all the waters of Shark Bay south of a line drawn from Cape Levillain to Greenough Point (Fig. 1).

CONCLUSIONS AND RECOMMENDATIONS

1. The 1960 snapper season was not a failure.

2. Sufficient evidence is not available to warrant the general banning of snapper traps.

3. It is recommended that the collection of statistical data relating to future snapper seasons be intensified.

4. It is recommended that the waters of Shark Bay south of a line drawn from Cape Levillain to Greenough Point be closed to the use of snapper traps.

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